Acoustic characterization of gadoid larval aggregations in Galician waters (NW Spain)

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1. INTRODUCTION

Although plankton has been studied acoustically for many years, the growing importance of this field is now evident (MacLennan and Holliday 1996). Recently, aggregations of hake larvae were detected using acoustic techniques in Argentinean self (Álvarez-Colombo et al. 2011). These authors showed the potential of the acoustic method applied to the detection and spatial distribution analysis of larval fish aggregations. This innovative use of acoustics should be contrasted not only in other fish species but also in different geographic areas. Therefore, the aim of this study was to test the hypothesis that larval fish aggregations may be detected and assessed by acoustics techniques in Iberian waters. We analyzed the acoustic records in order to describe horizontal distribution patterns of larval fish aggregations (mainly of the gadoid species blue whiting *Micromesisitius poutassou* and European hake *Merluccius merluccius*).

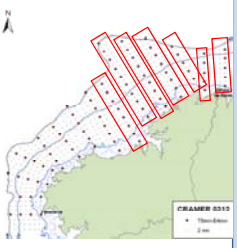
2. MATERIAL AND METHODS

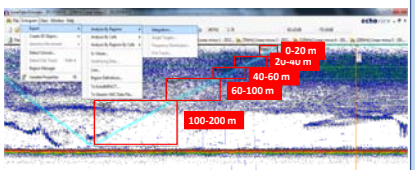
2.1 Sampling

Acoustic and biological samples were obtained onboard the *R/V Cornide de Saavedra* in the Galician shelf (NW Spain) during winter (February-March 2012). The acoustic equipment consisted of an EK60 echo sounder operating with 18, 38, 70, 120 and 200 kHz split-beam, hull-mounted transducers. Zooplankton hauls were conducted with a multiple opening/closing net MultiNet. A total of 7 transects were selected to analyze in this study.

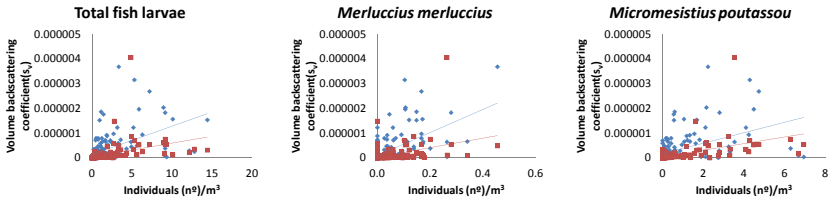
2.2 Acoustic analysis

Acoustic data were analyzed using Echoview. Noise from non biological organisms was subtracted from the echograms. After this first step, net trajectory was included in the echograms, with a specialized software, making easier the subsequent echo integration process.



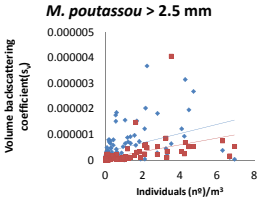


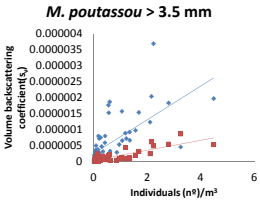
3. RESULTS AND DISCUSSION



The analysis of acoustic back-scattered energy (expressed as s_v) and density of larvae (estimated by net sampling) showed that, at 38 kHz (blue points) , the linear fit of *M. merluccius* larvae (R^2= 0.33) was better than the linear fit of total fish larvae (R^2= 0.27). However, at 70 kHz (red points), *M. poutassou* larvae have a better fit (R^2= 0.24) than total fish larvae (R^2= 0.17). The scattering due to zooplankton (fish larvae excluded) appear to be negligible at those frequencies.

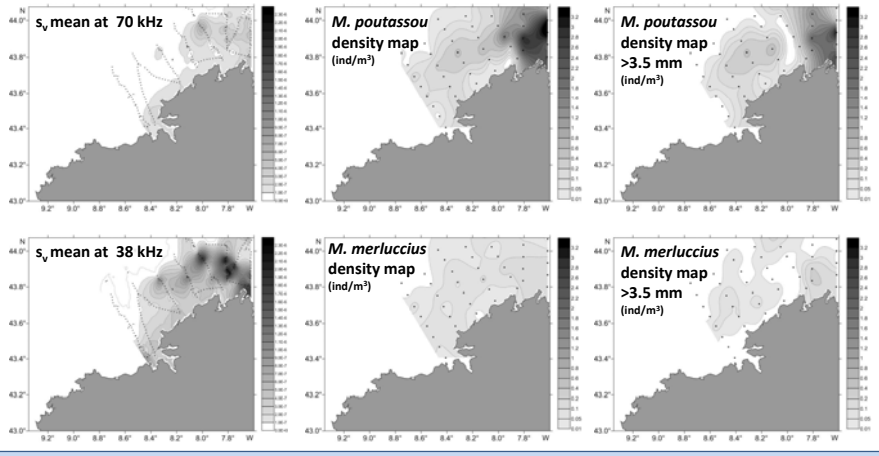
In the *M. poutassou* larvae, the linear fit improved when hauls with small average larval length of this species were removed. The linear fit, excluding hauls with average larval length equal to or smaller than 2.5 mm (R^2= 0.16 at 38 kHz and R^2= 0.20 at 70 kHz), is similar to the linear fit including all hauls (R^2= 0.17 at 38 kHz and R^2= 0.20 at 70 kHz). In contrast, when only hauls with average larval length larger than 3.5 mm were included the linear fit in this analysis clearly improved (R = 0.46 at 38 kHz and R^2=0.69 at 70 kHz). This fact suggests that the development of a functional swimbladder in *M. poutassou* larvae occurs at a length of *c.a.*3.5 mm.





The spatial distribution analysis showed a rough overlapping between the acoustic records (expressed as mean s_v) and the distribution of *M. poutassou* larvae, mainly in the map excluding hauls with average larval length equal to or smaller than 3.5 mm. In contrast, there was no overlapping between the acoustic energy and the *M. merluccius* larval distribution, probably due to the low larval density of this species.

All these results indicated that gadoid larval aggregations in Galician waters, particularly *M. poutassou* larvae, are able to be detected and quantified with a relative abundance index derived from acoustic methods. Even when *M. poutassou* larvae accounted for 43 % of total larvae caught, the contribution of larvae of other abundant species to the total scattering at the frequencies shown, will be considered in further analysis.



5. CONCLUSIONS

- Echo-sounding data may provide a viable methodology for the study of spatial and temporal changes and trends in abundance of gadoid larvae, in particular blue whiting.
- The characterization of larval fish aggregation will allow the mapping of their distribution by the analysis of previous acoustic databases.

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